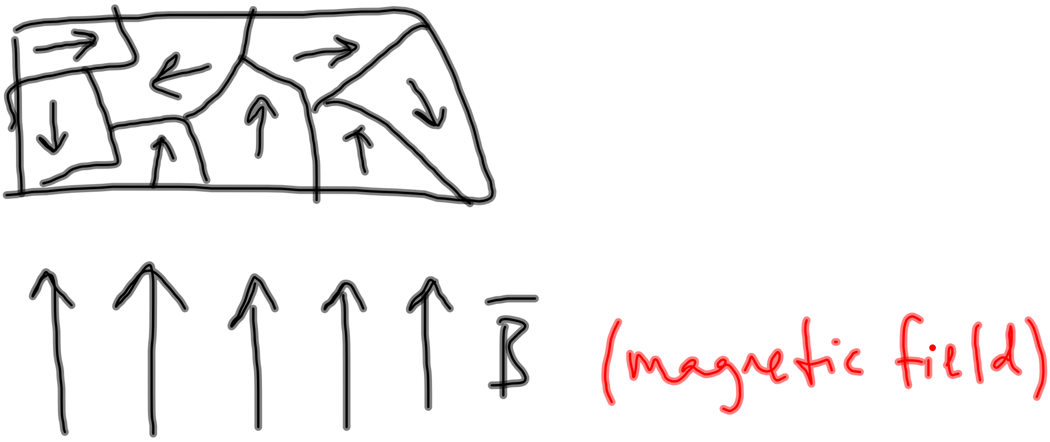
Magnetism Notes 11.28.11 AP Physics

(1)



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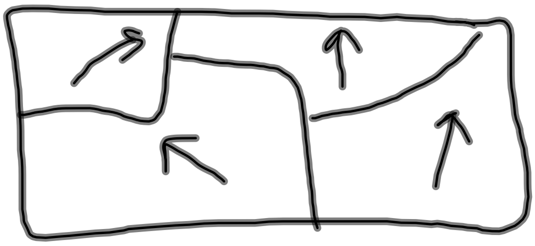

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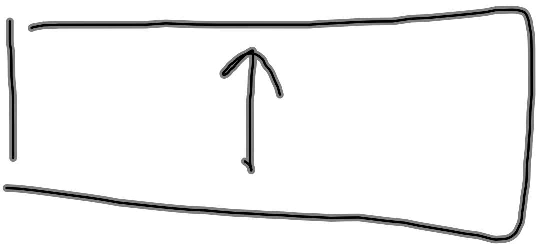
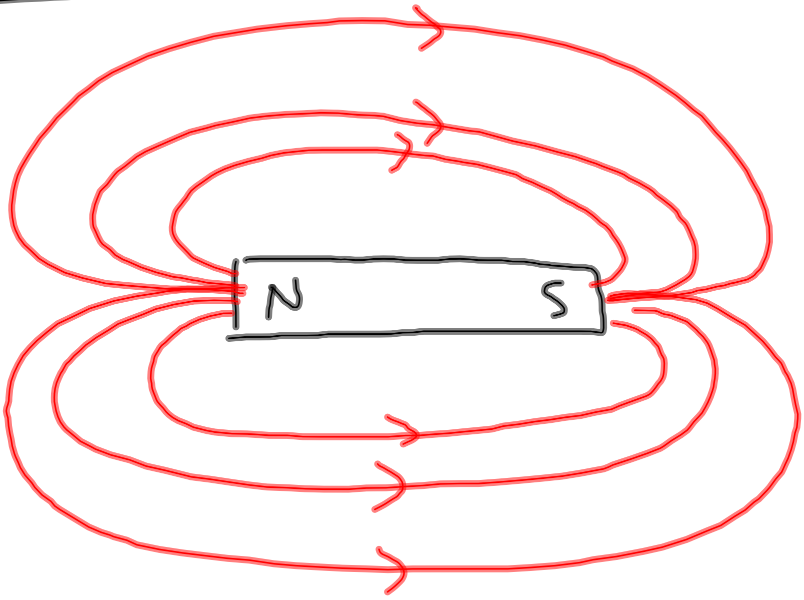
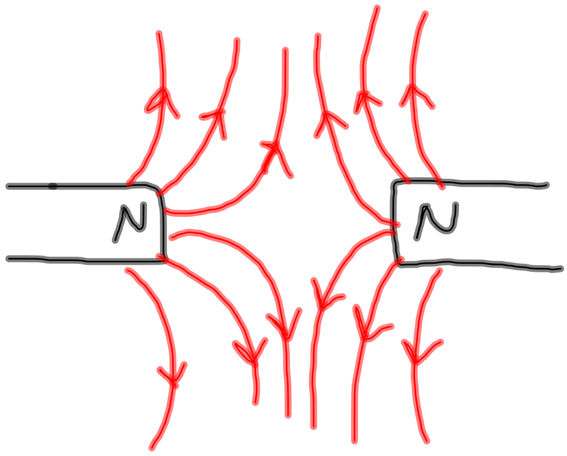


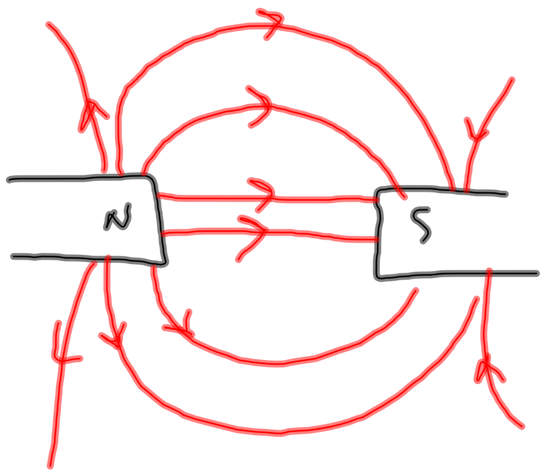
What do we already know about magnetism?

- opposites attract
- orientation of atoms
- magnetic force
- magnetic fields
- polarization of domains
- dipoles only
- $\vec{F}_B$ is a vector
- units of Gauss (non-S.I.)
- S.I. unit is Tesla
- ties into electricity
- need magnetic materials (sometimes)
- $\vec{B}$-field $\perp$ $\vec{E}$-field

Magnetic Fields:







Moving charges in a magnetic field:

- Experiments have determined:
  - magnitude $\overline{F}_B$ $\propto$ (is proportional to) charge (q) and magnitude of $\overline{v}$
  - when particle moves parallel to $\overline{B}$-field, $\overline{F}_B = \emptyset$
  - $\overline{F}_B \perp$ to plane determined by $\overline{B}$ and $\overline{v}$ vectors
  - $\overline{F}_B$ on positive charge is opposite $\overline{F}_B$ on a negative charge
  - magnitude of $\overline{F}_B \propto \sin\theta$, θ is angle between $\overline{v}$ and $\overline{B}$
- These observations lead us to:

$$\overline{F}_B = q(\overline{v} \times \overline{B})$$

magnitude: $F_B = |q| v B \sin\theta$

- Units of $\overline{B}$:

$$1 \text{ Tesla (T)} = 1 \frac{N}{C \cdot m/s} = 1 \frac{N}{A \cdot m}$$

non-S.I. → gauss (G)

$$1\ T = 10^4 \text{ Gauss}$$

Differences bet. $\bar{E}$ and $\bar{B}$:

1. $\bar{E}$ and $\bar{F}_E$ point in same direction,
   $\bar{B}$ and $\bar{F}_B$ are $\perp$

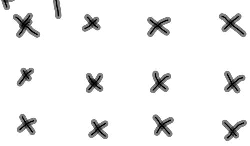
2. $\bar{F}_E$ acts on charged particle regardless if it is moving;
   $\bar{F}_B$ only works when charged particle is moving

3. $\bar{F}_E$ does work displacing a particle; $\bar{F}_B$ does not do any work

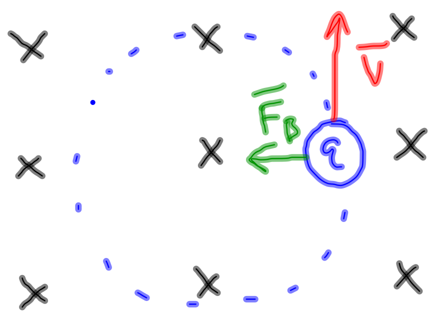
Drawing $\bar{B}$:

$\bar{B}$ points out of page

$\bar{B}$ points into page



Motion of charged particle in a uniform $\bar{B}$:



$$\Sigma \bar{F} = m\bar{a}_c$$

$$F_B = qvB\cancel{\sin\theta}^{\,1} \qquad F_B = \frac{mv^2}{r}$$

$$q\cancel{v}B = \frac{mv^{\cancel{2}}}{r}$$

$$r = \frac{mv}{qB}$$